

WHAT IS CLAIMED IS:

1. An injection catheter comprising:
a catheter body comprising a flexible tubing having proximal and distal ends and at least one lumen therethrough;
a tip section comprising a flexible tubing having proximal and distal ends, wherein the proximal end of the tip section is mounted at the distal end of the catheter body;
a needle control handle at the proximal end of the catheter body;
an injection needle extending through the tip section, catheter body, and needle control handle and having a proximal end attached to the needle control handle and a distal end within the tip section, wherein the injection needle is longitudinally slidable within the tip section so that its distal end can extend beyond the distal end of the tip section upon suitable manipulation of the needle control handle; and
an electrode lead wire having a first end electrically connected to the injection needle and a second end electrically connected to a suitable monitoring apparatus or to a source of ablation energy.
2. An injection catheter according to claim 1, wherein the first end of the electrode lead wire is connected near the proximal end of the injection needle.
3. An injection catheter according to claim 1, wherein the first end of the electrode lead wire is connected near the distal end of the injection needle.
4. An injection catheter according to claim 3, wherein the electrode lead wire comprises a pair of wires including a copper wire and a constantan wire that can act as a thermocouple.
5. An injection catheter according to claim 1, further comprising a protective tube in surrounding relation to at least a portion of the injection needle.
6. An injection catheter according to claim 5, wherein the protective tube surrounds the injection needle along substantially the entire length of the needle.

7. An injection catheter according to claim 1, further comprising at least one additional electrode mounted on the tip section.

8. An injection catheter according to claim 1, further comprising a tip electrode mounted on the distal end of tip section.

9. An injection catheter comprising:
a catheter body comprising a flexible tubing having proximal and distal ends and at least one lumen therethrough;

a tip section comprising a flexible tubing having proximal and distal ends, wherein the proximal end of the tip section is mounted at the distal end of the catheter body;

a needle control handle at the proximal end of the catheter body;

an injection needle extending through the tip section, catheter body, and needle control handle and having a proximal end attached to the needle control handle and a distal end within the tip section, wherein the injection needle is longitudinally slidable within the tip section so that its distal end can extend beyond the distal end of the tip section upon suitable manipulation of the needle control handle;

an electrode mounted on the injection needle near the distal end of the injection needle and electrically isolated from the injection needle;

an electrode lead wire having a first end electrically connected to the electrode and a second end electrically connected to a suitable monitoring apparatus or to a source of ablation energy.

10. An injection catheter according to claim 9, wherein the electrode is in the form of a ring mounted in surrounding relation to the injection needle.

11. An injection catheter according to claim 9, further comprising an electrode lead wire having a first end electrically connected to the injection needle and a second end electrically connected to a suitable monitoring apparatus or to a source of ablation energy.

12. A method for introducing a therapeutic or diagnostic agent into heart tissue of a patient comprising:

introducing the distal end of a catheter according to claim 1 into the patient's heart;

extending the injection needle beyond the distal end of the tip section;
determining whether the injection needle has penetrated the heart tissue; and
injecting a therapeutic or diagnostic agent into the heart tissue with the injection needle.

13. A method according to claim 12, wherein the determining step comprises measuring the impedance across the distal end of the injection needle.

14. A method according to claim 12, wherein the catheter further comprises at least one additional electrode at or near the distal end of the tip section.

15. A method according to claim 14, wherein the determining step comprises comparing the impedance across the distal end of the injection needle to the impedance across the additional electrode.

16. A method according to claim 12, wherein the therapeutic or diagnostic agent is selected from the group consisting of angiogenesis activators, angiogenesis inhibitors, and antiarrhythmic drugs.

17. A method for introducing a therapeutic or diagnostic agent into heart tissue of a patient comprising:

introducing the distal end of a catheter according to claim 9 into the patient's heart;
extending the injection needle beyond the distal end of the tip section;
determining whether the injection needle has penetrated the heart tissue; and
injecting a therapeutic or diagnostic agent into the heart tissue with the injection needle.

18. A method according to claim 17, wherein the determining step comprises measuring the impedance across the electrode mounted on the injection needle.

19. A method according to claim 17, wherein the catheter further comprises at least one additional electrode at or near the distal end of the tip section.

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20. A method according to claim 19, wherein the determining step comprises
5 comparing the impedance across the electrode mounted on the injection needle to the impedance
across the additional electrode.

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